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**To Defend the Temple:
Innovation in the Israeli Defense Force**

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The sight of burned and blackened figures stumbling or crawling from the ruins of their homes and workplaces evokes nightmarish memories of another era, one in which a previous generation of Jews was murdered and then immolated by their enemies. Some of the wounded, eyes melted from their sockets from the blinding light and heat of nuclear fire, are led by fellow victims whose skin has been ripped from their bodies by the intense heat and blast of the fireball. One shambling creature, just recently a pretty young mother, carries a sodden lump of flesh that had been a child unlucky enough to be in its crib near a large picture window when the sky became filled with the light of a thousand suns and then a thousand pieces of flying glass. These victims and dozens like them—without arms, without eyes, with untreatable burns, and radioactive death in their cells—slowly and agonizingly join other walking corpses in a macabre evacuation out of the remnants of Tel Aviv and toward the waiting desert.

To the north, in Haifa, the streets are eerily quiet. Hours before, several SCUD missiles impacted in the city and the population in the area immediately began choking, vomiting, and falling to the ground. Within minutes hundreds were dead or dying. Within an hour thousands were dead as chemical agents prevented their autonomous systems from maintaining life. By nightfall, the city was littered with the bodies of people, household pets, birds, farm animals, and even rats. Those men and women who for one reason or another did not die in the initial contamination soon did so because much of the medical expertise residing in the city died with the rest of the residents and were thus unable to administer antidotes to the contaminated victims who appeared in the hospitals. In a nightmarish reprise of history, an unseen chemical agent again brought death to thousands of Jews.

Taking advantage of the confusion and shock spreading throughout Israel by these atrocities and others like them, Arab armies swept in from the Sinai, the Golan, and the West Bank. The Israeli Defense Force weakened by the many deaths in its reserve forces, unable to coordinate operations due to the confusion and damage of the nuclear attack,

and distracted by the need to maintain some semblance of order in Israeli cities and towns, was overcome by Arab forces, but not before launching more than a dozen nuclear strikes of its own which destroy Cairo, Damascus, Baghdad, Teheran and some of the mass destruction capabilities of Iraq and Iran. Later, in Washington D C, the Commander of the Israeli Navy, who happened to be in the United States when the attack began was heard to tell the Israeli Ambassador to the United States in a voice quivering with emotion "This time, it truly is the end of the Third Temple. We must begin again."

The foregoing is, briefly, the current "nightmare scenario" that haunts the leadership of the Israeli Defense Force (IDF). In its 51 years of official existence, the IDF has faced a number of "nightmare scenarios" that contemplate the destruction of the State of Israel by its neighbors. Yet, from its founding to the present day, the IDF has not only prevented national extinction but has even achieved smashing victories over its adversaries through an extraordinary ability to learn from its mistakes, evolve new doctrine, remake its military organization, and even develop innovative technologies whenever necessary.

Israel is currently undergoing its own unique Revolution in Military Affairs (RMA) in response to its experiences in the Persian Gulf War of 1990-1991, as a result of regional military developments that give neighboring nations the capability to attack Israel with weapons of mass destruction, and due to a perceived need to keep up with general advances in conventional military technology around the world.¹ The Israeli RMA is similar in some ways to the RMA being pursued in the United States, but the Israeli RMA also displays distinctly Israeli cultural features.

A brief examination of the Israeli history of military innovation, and the evolution of the current Israeli RMA is useful because it provides a window on what one nation is doing to cope with its own emerging security challenges and may provide some insight to

¹ For a discussion of what constitutes a Revolution in Military Affairs see Andrew F. Krepinevich, *Cavalry to Computer - The Pattern of Military Revolutions*, The National Interest, Fall 1994, Pages 30-42.

U S planners and policymakers on what other nations might accomplish if they attempt to compensate for U S technological superiority and work around U S policies that attempt to restrict access to advanced military technology

This last statement might seem curious to readers who view Israel as one of the strongest U S allies in the Middle East today. However, an examination of Israeli history reveals that while the U S has always harbored some sympathy for Israel's aspirations and the struggles of its Jewish population, through much of its history Israel was considered a "rogue state" by much of the international community and there were periods when the United States actively opposed Israeli actions. This was certainly the case between 1950 and 1968. The Eisenhower Administration supported UN resolutions condemning Israel after the 1956 Arab-Israeli war.² Through the first 20 years of Israel's history, the United States generally refused to sell modern weapons or military technologies to Israel and often tried to prevent the new Jewish state from acquiring older U S equipment although to maintain something of a balance of power in the region it permitted the French to sell some weapons.³ The fact that tiny Israel was able to survive, develop an extremely competent military establishment, procure advanced foreign military equipment when necessary, meet many of its military requirements through an indigenous defense industry, and build and maintain its own nuclear deterrent despite the apparent opprobrium of much of the world community and early opposition from the United States and Great Britain should be a sobering lesson for policymakers who must deal with current rogue states.

The Concept and Process of Military Innovation Military history is replete with examples of both technological and organizational innovations that revolutionized the combat capabilities of the services involved. That same history reveals examples of ideas

² Howard M. Sachar, *A History of Israel from the Rise of Zionism to Our Time* 2nd Edition (New York: Alfred A. Knopf, 1996) page 503

³ Ehud Yonay, *No Margin for Error: The Making of the Israeli Air Force* (New York: Pantheon Books, 1993) page 7-13. Helen Chapin Metz (Ed.), *Israel: A Country Study* (Washington D.C., Federal Research Division, Library of Congress, 1988) page 320

and inventions that were not accepted by the services and were thus relegated to historical curiosities. These might-have-beens might also have generated RMAs, but somehow never took off. The process by which innovative ideas or technologies are accepted or rejected into an organization has become a subject of some interest to both military leaders and policymakers because the pace of innovative change is now occurring with such increasing speed and in so many scientific disciplines that it is difficult to know which might be useful for military purposes and which are likely to be dead ends. This is of more than academic interest because in the area of military innovation, incorrect decisions regarding the need for innovation or bad decisions about the type of innovation in which to invest could not only be expensive in terms of resources, but on the battlefield could be fatal.

In order to fully understand the process of military innovation it is useful to consider innovation as a concept. Several authors on this subject have noted that innovation can be considered almost any change in technology or methodology that seems to improve the efficiency or output of an existing process or activity. Viewed in this way, almost any improvement in procedure or acquisition of an improved piece of equipment could be an innovation. The limited scope of innovation in these cases usually, but not always, brings evolutionary, rather than revolutionary, change and constitutes little more than an improvement in the accomplishment of tasks already being performed.⁴ This type of improvement is usually less interesting to the student of innovation because it seldom results in transformations in thought or overall conception regarding the possibilities of the technological innovation or of the organization as a whole.

In contrast, innovations that radically alter existing organizations, create new institutions, or represent a significant departure in expected output are extremely interesting. These are the innovations that can ignite a RMA. Revolutions in Military

⁴ In the Israeli case this type of evolution might be exemplified by the difference in capabilities displayed in the 1956 and 1967 wars.

Affairs by their very nature change the “grammar” of conflict and often the conception of what constitutes “modern” warfare. The elements that can be shown to definitively contribute to such a transformation remain to be identified.

While there is a good deal of anecdotal or biographical literature on specific individuals involved in innovation or on the development of a particular innovation, analytical literature on how modern military innovation takes place is actually quite sparse and almost all of it relates to major powers of the past or present. This is, perhaps, natural since it is usually the major nations that have the scientific, economic, and military wherewithal to be the major implementers of global military change. Stephen P. Rosen, for example, emphasizes the actual military requirements in such nations as the United States and Great Britain and argues that these are the basic catalysts for change. He also examines the role determined individuals who wish to change a military organization can play in implementing change. Without question, Rosen’s work is an important study on the process of military innovation and his basic assertion that in the final analysis security requirements drive military innovation is probably correct. However, his distinction between peacetime and wartime innovation is one that may be applicable only to nations such as the United States or Great Britain which have historically not felt threatened in peacetime due to their relative geographic isolation. Nations which have felt threatened even when there is not an actual state of war due to the existence of a proximate military adversary might not differentiate between peacetime and wartime innovation with the same clarity as the two “island” nations cited by Rosen.⁵

Barry Posen’s hypothesis that innovation occurs when there has been or may soon ~~be~~ be a military failure may also be the most significant explanation for innovation in many nations of the world.⁶ As Charles Stevenson has pointed out innovation in most

⁵ Stephen Peter Rosen *Winning the Next War: Innovation and the Modern Military* (Ithaca: Cornell University Press, 1991).

⁶ Barry R. Posen *The Sources of Military Doctrine: France, Britain, and Germany Between the World*

bureaucracies, especially military bureaucracies, is unusual because it disrupts norms, dislocates the relationships among the personnel in the bureaucracy, and creates uncertainty.⁷ It is thus reasonable to suggest that only the prevention of a major transforming event would justify the creation of a 'major preemptive transformation in those nations with limited resources and facing proximate military threats. This might also explain why many, perhaps most, of the RMAs of history began in nations surrounded by enemies. An examination of the security challenges facing a nation such as Israel combined with an understanding of the local proclivity for innovation may provide clues as to what pre-Revolutionary conditions might be required to generate revolutionary innovations.

In nations where the need to stay ahead of nearby adversaries is obvious, the role of the 'hardheaded individual' who undertakes extraordinary professional and bureaucratic actions in his quest to transform his nation's military establishment in nations may be less important in the innovation process than in nations such as the U S or Great Britain. This is not to suggest that there might not be individuals that foster an idea nor that there might not be mentors who resource the ideas and move them along. Rather, in a climate in which it is widely recognized that change is required, the "hardheaded individual" may be pushing on an open door to get change to occur.

It should also be noted that for most nations of the world, major innovation often means effecting similar technological, doctrinal, and operational concepts as a potential adversary or ally. One of the hallmarks of RMAs is that while they may originate in one nation, they spread to other nations ultimately transforming the global nature of war itself. Thus within each global RMA there are a myriad of national RMAs that involve local

Wars (Ithaca: Cornell University Press, 1984) pages 55-58

⁷Charles A. Stevenson, *Dynamics of Military Innovation*. An Unpublished Paper Prepared for the Bi-ennial Conference on the Inter-University Seminar on Armed Forces and Society, Baltimore, Maryland, October 24-26, 1997, page 1.

redefinition of military culture, doctrine, organizational changes, and perhaps the advent of even more modern technologies designed to defeat the technological innovations of the potential threat. Thus, for many countries with limited resources adopting the military culture, doctrine, organizational concept, and technology of another nation, may be a local RMA in itself and an engine for indigenous innovation in the future. The Israeli model would seem to bear out this hypothesis as well.

The Israeli Cultural Environment In order for innovation to occur, an essential prerequisite is a culture suitable for innovation and experimentation or one that can be made so. This means not only a willingness to develop new ideas and experiment with them, but also a culture in which the iconoclast is tolerated. The Israeli Defense Force (IDF), like the military establishment of any nation, is a reflection of the society from which it emerges and serves. Given Israel's history of experimentation and innovation, the proclivity of the IDF to innovate is both natural and understandable.

In many ways the State of Israel is a product of rebellion, experimentation, and innovation. Toward the end of the 19th century, Zionism became an organizing ideology for Jews desiring a return to Palestine and the establishment of a Jewish state. The Zionists, however, developed an ideology which rejected much of what the world believed it knew about Judaism.

Throughout the Middle Ages and into the modern era, Jews, particularly in Eastern Europe, had been relegated to such jobs as tailors, jewelers, and shoemakers. In order to get along in the societies in which they lived, the Jews had in many ways become subservient and meek. One author has even noted that rabbis and Talmudic scholars subtly began altering Jewish history transforming, for example, the warrior king David into a scholar and in general de-emphasizing the military past of Israel and the Jewish people.⁸

⁸ Martin Van Creveld, *The Sword and the Olive: A Critical History of the Israeli Defense Forces* (New York: Public Affairs Press, 1999), page 10.

The Zionists rejected the tradition of the weak, shifty Jew and instead developed the concept of the strong, robust Jew who would transform the desert with his labor and his knowledge

In addition to this transforming cultural concept of Jewishness, the Zionist movement was socialist in its political orientation. In the late 19th and early 20th Centuries, Socialism and Marxism were ideologies that appealed to intellectuals and skilled urban workers. These beliefs were touted as “scientific” because they were based not only on theoretical constructs, but also observations of actual world conditions of the time which in turn seemed to “prove” the validity of the theoretical constructs. Jewish culture traditionally emphasized education and honored scholars and wise rabbis. Every family wished at least one of its sons to go to a university, become a learned rabbi, or some other kind of knowledge-based professional. These various cultural and political threads came together in the latter part of the 19th Century to bring many educated and professional Jews into the Zionist movement, Western European Socialist parties, and even Russian Marxist and Socialist revolutionary organizations. Much of the intellectual drive of the leftist political movements of the era came from its educated Jewish members. Karl Marx himself was Jewish.⁹

It was not only in political and social thought that Jewish intellectuals were making themselves felt, the *fin de siècle* era also witnessed a flowering of Jewish intellectual gifts in the natural sciences. In Western Europe, Jewish scientists, engineers, and technical specialists were transforming the technological face of the continent. Jewish scientists were redefining the very paradigms by which the cosmos were understood. In 1905, Albert Einstein published his Theory of Relativity which transformed the scientific community’s views about the laws of the universe. Simultaneously, Sigmund Freud was

⁹ For a more extensive study of the intellectual roots of Zionism and leftist ideologies in Europe see Walter Laquer *A History of Zionism* (New York: Holt, Rinehart and Winston, 1972).

engaged in redefining what it meant to be a human being Throughout Europe, especially in Western and Central Europe, Jewish doctors, scientists, engineers, and technical specialists proliferated ¹⁰

The earliest Zionist settlers who arrived in Ottoman Palestine in 1905-1907 were the heirs of a robust tradition of intellectual activity, scientific experimentation, and engineering experience Moreover, many of the settlers were products of European universities and technical schools themselves Upon arrival in Palestine they began to put their expertise to work to build socialist *kibbutzim* in the countryside and to develop flourishing businesses and professional practices in the cities It is one of the great epics of Israeli history that the hardy Zionists came to Palestine and “made the desert bloom” However, as the current Science Advisor to the Israeli Prime Minister reminds us, they did this through solid engineering projects using scientific farming methods, irrigating the desert, by using innovative methods to more efficiently use water, and by developing plant species that could survive in a desert environment ¹¹

It quickly became apparent to the local Arab population that the Jewish immigrants were set upon taking over the region and perhaps becoming a Jewish nation Many Arab families that had lived on and cultivated particular plots of land now found themselves evicted or abused by the new owners Soon, violence broke out between the Jewish immigrants and Arabs Initially, these skirmishes were little more than armed bands shooting at each other as neither side had a great deal of military experience or large numbers of fighters However, one of the turning points of these early struggles occurred when the Jewish settlers imported bullet packing machines from Europe ¹² By being able to produce their own bullets, the Jews were not as restricted in the number of rounds that

¹⁰ A recent book which directly addresses Jewish contributions to the industrial and scientific development of Europe are David S. Landes *The Wealth and Poverty of Nations: Why Some Nations are So Rich and Some So Poor* (New York: W. W. Norton and Company, 1998)

¹¹ Science Advisor to the Prime Minister *National Science Policy Goals* (State of Israel Website, 1998)

¹² Van Creveld *op cit* page 15

they could expend. The Arabs, lacking the same technical expertise and thus unable to emulate the Jews, continued to be dependent on the rounds they could buy or steal from the local Turkish authorities. Through the beginning of World War I, this small technological innovation allowed the Jewish immigrants to maintain a general military advantage over their Arab neighbors.

Fighting between Arabs and Jews grew more intense after the First World War. It is not the purpose of this essay to discourse on how the World War impacted the foundation of the State of Israel. It is important to note however that the Balfour Declaration re-energized the Zionist quest for a homeland and prompted the local Arabs to redouble their efforts against the Zionist immigrants. Jewish immigration in the immediate aftermath of the World War brought to Palestine Jews who had combat, military, or military research experience. The debris of the war in the Middle East allowed both sides to acquire better weapons. Immediately available to both Jews and Arabs were Turkish, German, British, and even Austro-Hungarian firearms as well as explosives, mines, and other weapons. Caught between the two warring communities was the new colonial power, Great Britain. The British were generally a more technically effective occupying force than the Turks had been. Throughout most of the inter-war period, the motivations of the British were to maintain peace in a region in which, ironically, British promises to both sides had done much to instigate conflict. The British approach was often to assume that both sides were equally guilty of violence and attempt to stamp out the action arms of both the Arabs and the Zionists.

Despite the efforts of both the Arabs and the British, the Jewish Agency's quasi-military organization, the *Haganah* (literally "Defense"), developed a number of innovative approaches to meet its material needs. When British authorities made military weapons more difficult to acquire locally and more difficult to smuggle in, the *Haganah* established small gunsmithing workshops that could repair and sometimes even replicate weapons and put them in the hands of Jewish fighters. The *Haganah* also added armor to

their cars and trucks and used them to patrol roads between *kibbutzem* and occasionally in support of walking troops (one hesitates to call them infantry at this time) Banned from possessing aircraft with obvious combat potential, the *Haganah* nevertheless established a flying club which trained young Jewish pilots in the basics of flying ¹³

As the world moved closer to a second World War, there was considerable debate within Jewish Palestine about the appropriate course of action to take The trickle of Jewish refugees from Germany in the 1930s gave the Palestinian Jews the first inkling of the horror which was about engulf the Jewish communities of Europe Nonetheless, many young Zionists exhibited great reluctance to join the British armed forces Many of the Jews in Palestine quite naturally viewed Great Britain as a colonial oppressor which was preventing the creation of an independent Israeli state Despite this sentiment among many members of the Jewish community in Palestine, David Ben-Gurion and other influential leaders of the independence movement argued that if the Allies lost to Germany, the plight of Jews everywhere would be much, much worse than under the British Moreover, Ben-Gurion argued that service in the British armed forces would provide valuable knowledge and experience to future leaders of an Israeli armed force This view eventually prevailed and during the Second World War, thousands of Zionists from Palestine served in the British Army, the Royal Air Force, and the Royal Navy In addition, others served in the various British intelligence organizations during the war providing yet another type of experience base for the future

At the conclusion of the Second World War, the Palestinian Jews returned home with a variety of experiences Some of the more famous Israeli combat commanders in the 1948-1967 period had their formative military experiences in the British Army Many of the early Israeli Air Force pilots and leaders had service in the RAF, the RCAF or the American air forces These men returned with a greater understanding of both the

¹³ Yonay *op cit* pages 77 121 193

organization and tactical operation of military forces. Generally less understood but perhaps equally important, many of these individuals returned home with an appreciation of how technology, doctrinal changes, and other innovations had changed the nature of war and how such advances could be exploited so that small numbers of quality soldiers could defeat large numbers of lesser troops.

In contrast, the Arabs gained very little practical military experience in the Second World War. They had often been mistrusted by the British and the French, not least because several prominent Arab leaders were found to be working with the Germans to overthrow British and French rule in North Africa and the Middle East. Arab soldiers were less familiar with the technological innovations wrought by the war. Thus, the worldview and military expertise of the Arabs changed little. There was clearly less emphasis on innovative technology or new doctrine in the emerging Arab states than among the Jews in Palestine. By the time of the Israeli declaration of independence in 1948, the Jews had a number of small factories that produced small arms, explosives, ammunition, mines, anti-tank weapons, and a number of other military items. More importantly, the nascent Jewish state had created a defense concept in which innovation and independent thinking were major components. This was in contrast to the Arab states which generally relied on outsiders for both military equipment and doctrine and were thus dependent on the vagaries of those relations for much of their military capabilities. These traits were to continue when Israel became an independent state and have continued down to the present day.

The Role of Personalities and Military Requirements Throughout its short history, the Israeli armed forces have proven to be innovative both in the use of new techniques and technologies. The State of Israel itself was born of rebellion and relied on innovative individuals to secure both its independence and its security. It is perhaps natural then that the IDF has had more than the expected number of innovative thinkers and iconoclasts. However, a close examination of these individuals indicates that their worldview regarding

the threat is generally consistent with the leadership of the IDF and without exception their innovations, whether technological or methodological, have addressed an existing Israeli military requirement. Israeli innovations have been historically based on an existing technology or methodology but the often extreme conditions of the Middle East generally require Israeli military officials to “push the envelope” to such an extent that the results have often been revolutionary. It has been said that quantity is a quality all its own, but the Israelis demonstrate that innovation and quality can match quantity as well.

Much has been written about the development of the Israeli Army and Air Force in the years between Independence and the 1967 War. As the world knows, both services, and to a lesser extent, the Israeli Navy, developed innovative tactics and operational techniques that allowed them to simultaneously defeat several larger Arab armed forces in 1949, 1956, and 1967. Israeli tactics became so refined that the 1967 war in particular was, and is, regarded as nothing short of miraculous by many outside observers as well as many Israelis themselves.

However, almost as soon as the 1967 war was successfully concluded, the Israelis faced the beginnings of a trauma which was to instigate their own Revolution in Military Affairs. Beginning in 1969 and continuing through 1970-71, the Israelis confronted the Egyptians across the Suez in what became known as the War of Attrition. In those years, the Soviet Union replaced Arab losses of tanks and aircraft. In addition, the USSR began to provide the Egyptians with sophisticated surface-to-air missile (SAM) systems. Moreover, when the Soviets themselves manned these systems and greatly increased their numbers, they began shooting down Israeli aircraft at an alarming rate. The American-built A-4 Skyhawk and even the F-4 Phantom II aircraft, which had been thought to be almost invulnerable, were being shot down with disquieting frequency. This Soviet-Egyptian capability constituted an enormous threat to the Israelis because an Israeli Air Force which could maintain air superiority or dominance could provide close air support to the ground forces and constituted the first line of defense of the Israeli nation. Moreover, the Israelis

aerial threats such as anti-aircraft guns and interceptors. They were also subject to error. A single aircraft carrying an electronics pod which was slightly out of position could negate the entire formation. For an Air Force accustomed to more free-wheeling operations, the continued loss of aircraft meant the “electronic” solution was a failure.¹⁵

This debate had not been resolved by the outset of the October 1973 Yom Kippur War. The Egyptian missile array had not been defeated either. Because reconnaissance aircraft could not easily overfly the Egyptian positions, intelligence collection and analysis was degraded causing the Israelis to be surprised at the outset of the war. The attack of the Egyptians across the Suez Canal under the “umbrella” of the SAMs deprived the beleaguered Israeli ground forces of both air superiority and close air support. Ultimately, the Israelis won back the air because the Egyptians made a strategic error in attacking faster than their missiles could move. As Egyptian ground forces moved out from under the SAM “umbrella” the Israeli Air Force could once again attack them. In addition, once the Israeli ground forces crossed the Suez Canal, they could attack the missile complexes from the rear opening up a “hole” in the array for the Air Force to exploit. History records that the Israelis won yet another military confrontation with their Arab neighbors, but the severe losses of planes and personnel by the Air Force was so traumatic that it transformed the thinking and changed the direction of that service to this day.

The near-loss of the Yom Kippur War virtually ended the “physics versus electronics” debate. The Israelis became believers in the value of electromagnetic technology. The technical section of the service became extremely important and in the years afterward many of the Israeli Air Force’s leaders had at least one tour dealing with research, development, or the acquisition of advanced technology.¹⁶ Israeli pilots and flight crews

¹⁵*Ibid* pages 292-298

¹⁶ One example of the change in career emphasis is Air Force Maj Gen Issac Ben-Israel. Director of Research and Development, Israeli Ministry of Defense. Ben-Israel was a lieutenant and an electronic warfare specialist in 1973. Air Force Maj Gen Issac Ben-Israel, Director of Research and Development, Israeli Ministry of Defense. *Defense News*, August 17, 1998 (Army Times Publishing Company, 1998).

needed air superiority in order to conduct aerial reconnaissance as an early warning of Arab attack. If Israel's Arab adversaries could achieve surprise and meet the Israeli Army on something like even terms, the larger numbers of the Arab armies might permit them greater successes than in the past.

How to cope with this new threat generated much discussion within the senior ranks of the Israeli Air Force, a discussion that has come to be called the "physics versus electronics" debate.¹⁴ A large number of senior officers, many of them commanders of Israeli fighter squadrons or bases, believed that the missile threat could be defeated in the manner in which Arab threats had been defeated in the past. They believed that superior technique and piloting skills, that is, "physics", could defeat the Suez missile array. However, the Israeli Air Force Commander, Major General Benjamin Peled, and other officers, many of whom were technically educated and had tours involving research and development, believed that the only way to defeat the new threat was through the introduction and use of new, more sophisticated, electronic warfare devices. These officers also believed that Israeli combat doctrine should be adjusted to accommodate the new electronic warfare (EW) weapons and should specifically address the new missile threat.

There were several reasons why the debate continued as long as it did with such often tragic results. First, there was the strong cultural bias within the Air Force in favor of solving this military challenge through piloting skills and technique. Second, when the missiles were first introduced, even the United States was unprepared for some of their parameters and thus the initial countermeasures offered by the U.S. did not always work. Third, the piloting requirements needed to make the initial EW devices work, such as flying in complicated formations for long periods of time, were unpopular because they were difficult to maintain and put the planes and pilots at some risk from more traditional

¹⁴Yonay *op cit*

aerial threats such as anti-aircraft guns and interceptors. They were also subject to error. A single aircraft carrying an electronics pod which was slightly out of position could negate the entire formation. For an Air Force accustomed to more free-wheeling operations, the continued loss of aircraft meant the “electronic” solution was a failure.¹⁵

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began training with the new equipment and IAF combat doctrine was modified to utilize it effectively. The Air Force also purchased advanced E-2 Hawkeye airborne warning and control (AWACs) aircraft from the United States while attempting to develop such a capability indigenously. The Israelis also looked into purchasing satellites for reconnaissance while attempting to develop that technology locally as well. The genesis of the Israeli space program and the expansion of much of its electronics industry began with the near-defeat of the Yom Kippur War.

Moreover, the Air Force as a whole underwent large organizational and conceptual changes. In the years prior to the 1973 War, the world had been dazzled by the aerial brilliance of the fighter element of the Air Force. Many observers did not realize that while the fighters in the IAF might be the best available, other members of the service were often flying relics from World War II. Transports, for example, were extremely old and decrepit. A bomber force was virtually non-existent. The Israelis initially had nothing but disdain for helicopters as combat aircraft and refused U.S. offers to sell them the Cobra gunship. However, the wartime requirement of moving troops and equipment rapidly from one front to another, including movements which necessitated crossing the Sinai Peninsula, the need to destroy Arab tanks at a distance, and a requirement to reach out of area locations targets resulted in the transformation of the IAF from a predominantly fighter force with a few appendages to a more balanced force of fighters, transports, and other aircraft. Career patterns changed accordingly.¹⁷ The success of this conceptual transformation was demonstrated just a few years later when the IAF transported an Israeli commando force to Entebbe, Uganda to rescue Israeli hostages. Such an operation would have been impossible prior to 1973.

If anything, the trauma of the October War was even more severe in the Israeli Army. Like the Air Force, the Israeli Army prior to 1973 had been dominated by a single component, the armored branch. All Chiefs of the Israeli Defense Force in the years from 1956 to 1973 were armor officers and the Chief of the Armored Branch was senior in rank to the chiefs of the other army branches. Many of the best supported units of the Israeli Army were tank-heavy formations. This was in contrast to armies such as that of the United States which had developed balanced combined arms formations. Like the Air Force, Israeli armor units possessed some of the best equipment that could be built or purchased. Like their Air Force colleagues, armor officers prior to 1973 believed that the new Arab threats could be defeated by superior technique and therefore did not devise new technology to overcome them although some work on new tactics was undertaken.

In contrast to the armored forces which had the best equipment available, infantry soldiers were treated as second class troops in many ways. Infantry units did not have an effective, modern armored personnel carrier and often went into combat in ancient World War II half-tracks. Artillery was also neglected. There had been some work prior to 1973 involving development of a self-propelled artillery piece made from the hulls of Arab armor captured in 1967, but the effort had been desultory. The number of artillery pieces in the Israeli Army was small in comparison to the number of tanks and infantry.

The first week of the Yom Kippur War was a singular shock to the Israeli Army. Israel lost tanks rapidly and in large numbers. Several battalions were virtually wiped out and others survived with only a few tanks remaining. Israeli tank commanders had been trained to position their heads and upper bodies outside the protection of steel turrets so as to have a better view of the battlefield and to aim the main gun. An extraordinary number of commanders were killed because they were physically exposed to the effects of the modern weaponry which the Egyptians and Syrians had acquired. In previous wars, the Israelis had an advantage in being able to hit targets from a greater distance due to their superior training. In the 1973 war, ill-trained Arab infantrymen with anti-tank rockets

negated that training and scored kill after kill. Individual tank crews and commanders rapidly adjusted to the changed reality on the battlefield, but as an organization, the Army was demoralized and confused.

The ground war was also ultimately won by the Israelis but at a cost. Israel had suffered higher per capita casualties than any previous war except perhaps the War of Independence. In the Sinai, the Egyptians had scored enough of a military victory to seriously negotiate the return of the Sinai Peninsula and general peace terms with the Israeli Government. In the Golan, the Syrians had in fact broken through the Israeli lines but had lacked the ability and initiative to exploit their achievement. Ultimately, they were pushed back and the Israeli northern front was secure, but not before the war nearly escalated beyond anything imagined. There are reports that Defense Minister Moshe Dayan frantically telephoned Israeli Prime Minister Golda Meir when the Syrians broke through in the north and screamed "this is the end of the Third Temple" signifying that Israel was going to be defeated and destroyed. It is also reported that at that point, Israel considered using nuclear weapons in battle for the first time and actually began their deployment before the war ended in a superpower-brokered cease-fire.¹⁸ In all, it had possibly been a "very near-run thing" for the Israelis and the world.

Almost as soon as the war ended, technological, and organizational changes were initiated in the Army. The existing Army leadership was removed and replaced. It was no accident that the next Chief of the Staff of the IDF, LTG "Motta" Gur, was a paratrooper rather than a tank officer. Reorganization of the Army involved the transformation of armor formations into combined arms units. New equipment was purchased including large numbers of U.S. M113 armored personnel carriers for the infantry and self-propelled 8 inch howitzers for the artillery. Locally produced self-propelled artillery was also finally

¹⁸Seymour M. Hersh, *The Samson Option: Israel's Nuclear Arsenal and American Foreign Policy* (New York: Vintage Books, 1992) page 223.

developed Infantry soldiers were given their own anti-tank capabilities with the acquisition of tube-launched, wire-guided missiles (TOWs) and Dragons

Even Israeli tanks underwent improvements Large numbers of M-60s were purchased New guns and armor were added to the Israeli-produced *Merkava* to better counter Arab T-62 tanks acquired from the USSR The Israelis also introduced refractive armor These were small boxes of explosives designed to deflect incoming antitank rockets before they did damage to the tank itself More accurate aiming devices were also added including early laser targeting equipment ¹⁹ The helicopter, both armed and transport types, although organizationally part of the Air Force became integral to ground operations Under several technology-minded Chiefs of Staff, the Israeli Army also acquired a substantial array of electronic warfare weapons Van Creveld has noted, as have others in the IDF, that after the October 1973 war there was a perceptible shift from fighters to technicians in the IDF ²⁰

Without a doubt the near-loss of the 1973 Yom Kippur War was a watershed event in the history of the IDF Like the Germans after World War I and the U S military after Vietnam, the 1973 experience caused the Israeli armed forces to completely rethink their entire concept of air and land defense The period of 1974-1982 was a period of great innovation for the Israeli defense establishment as organizational, and technological innovations transformed the Israeli service from a relatively informal military organization to a modern bureaucratic and technologically-oriented force The shock of the 1973 experience is never far from the minds of many current Israeli military leaders who fought in that war as junior officers and is one of the singular experiences that continues to effect the Israeli forces to this day

¹⁹ Van Creveld *op cit* pages 275-76

²⁰ *Ibid* page 322

Institutionalizing Innovation. The evolution and growth of the Israeli defense industries sector has paralleled the growth of the State of Israel and the IDF. From its earliest beginnings providing bullets and repairing light weapons for Jewish fighters, the industrial sector grew until by 1988 there were about 150 defense-related firms in Israel. Some of these were state-owned enterprises, others were mixed, and some were privately owned.

The Armament Development Authority, commonly called Rafael, is under the direct control of the Ministry of Defense and is responsible for translating the field requirements of the IDF into projects and ultimately weapons for the various elements of the IDF. Israeli Aircraft Industries, another government-owned firm produces aircraft and avionics for the IAF as well as missiles, some armored vehicles, and even patrol boats for the Israeli Navy. Israeli Military Industries factories manufacture small arms such as the Uzi and Galil rifles, explosives, and other ammunition. It also upgrades armored vehicles.²¹

In the past, more than 20 percent of the Israeli industrial work force has been employed in these and other defense-related industries. Clearly the large percentage of the workforce engaged and the amount of resources expended in this endeavor has political implications for both the IDF and the nation as a whole. Virtually all of the available literature on these industries suggests that they respond to IDF military requirements and do not lobby for pet weapons systems or attempt to influence procurement decisions. However, there are some hints in some of the more recent literature that there may be more of a symbiotic relationship than existed in earlier periods not least because the management of these industries has recognized that in order to remain economically viable the industries must also produce for a larger world market. It is possible that as time goes

²¹Metz *op cit* page 315-316

on, the IDF may not be the exclusive or even the most important determinant of technical innovations in the Israeli industrial sector ²²

Lebanon and the Gulf War In June of 1982, the Israeli Government decided to deal with the issue of PLO incursions into northern Israel originating from southern Lebanon. They recognized that the region was virtually under the military control of the Syrians and that the PLO was also under Syrian protection. To prosecute the ground war it was necessary to eliminate the Syrian air and missile threat in the Bekaa Valley. This was accomplished with stunning success when the Israeli Air Force shot down some 80 aircraft and destroyed 26 missile sites with the loss of only one Skyhawk and two helicopters ²³. It was clear that the doctrinal and technological innovations undertaken by the IAF after the 1973 war were successful against the conventional threat posed by Syrian forces.

However, once the Israeli Army crossed the border its troubles multiplied. Army units easily defeated conventional PLO paramilitary and Syrian military units when they appeared. However, they were less capable of defending against the virulent *Hizbollah* guerrilla forces which began attacking Israeli units whenever the opportunity presented itself. The initial war of movement which the Israelis had perfected in three major wars ground to a halt and although they continued and still continue to hold an enclave in southern Lebanon, the costs have been high. In essence, the Israeli Army has been engaged in a protracted guerrilla war in the area for 17 years and continues to take casualties. In a country as small as Israel each casualty is deeply felt. The Israeli population, like its American counterpart, has become extremely casualty averse when questionable strategic goals are at stake. As a result of this casualty allergy, the role of Israel in southern Lebanon has come under question politically.

²²Steve Rodan quotes an Israeli defense official in his recent article 'Research Development Cuts Concern Israelis' *Defense News* November 30, 1998 (Army Times Publishing Company, 1998). This official said: 'The Americans are interested in things they don't have. If we can't bring them new things they won't be interested.'

²³Yonay, *op cit* page 358

In an effort to reduce casualties in Lebanon, the Israeli government initiated research in unmanned aerial vehicles (UAVs) in order to conduct reconnaissance in areas where shoulder-fired missiles or armed guerrillas made manned reconnaissance extremely dangerous.²⁴ This technology has since been used extensively by the Israeli armed forces in areas other than Lebanon and has also been made available to other nations through military sales.

Through most of the Lebanese guerrilla war, the Air Force viewed itself as a supporting force providing fixed wing and rotary wing transportation to the ground forces as well as providing close air support and air assault assets when possible. However, the domestic political aversion to ground casualties has prompted the Air Force to accelerate research in advanced sensors, precision guided munitions, and internetted command, control, communications, and intelligence systems in order to develop a capability of waging counter guerrilla operations from the air where the risk of Israeli casualties is much lower. While the Israelis believe such a 'system of systems' has clear application for conventional operations, it is interesting that the Israeli Air force is specifically attempting to build such a system to enhance its Low Intensity Conflict (LIC) capabilities. This is almost the opposite of the U.S. conception which seems to envision and describe its use more frequently in a conventional environment.²⁵

The Lebanese War has brought other changes in the complexion of the Israeli armed forces that may presage further innovative changes in the future. In the Air Force for example, helicopter pilots and transport pilots have gained a professional credibility that previously had only existed in the fighter community. As these officers rise in rank and responsibility, the roles, doctrine, and culture of the Air Force may change. In the Army, special forces and infantry officers are also gaining in command positions and prestige.

²⁴ Van Creveld *op cit* page 277

²⁵ Steve Rodan, 'Israel Looks for Technology to Fight Hezbollah Guerrillas' *Defense News* December 14 1998 (Army Times Publishing Company. 1998) page 18-19

Special forces and paratroopers had always been highly respected, but the Lebanese war has now moved these officers to even more prominence. This also might portend changes for the Army in the future.

Alarming as the casualties in Lebanon have been, perhaps the greatest military shock to the Israelis since the 1973 war was the Persian Gulf War of 1990-91. For the first time since Independence, Israeli cities came under direct attack from Arab weapons and the IDF did not respond in kind. Perhaps more significant for Israeli military strategists and commanders was that the attacks came from Iraq, a nation which has no common border with Israel and which the Israelis knew had been attempting to develop weapons of mass destruction since the early 1980s. The 1981 Israeli air attack on the Osirak nuclear reactor was an attempt to forestall just such an Iraqi nuclear development.

The Israeli response to the Iraqi attacks of the Gulf War and the subsequent developments of long-range missiles and weapons of mass destruction in the Middle East region have been nothing less than a Revolution in Political Affairs as well as a Revolution in Military Affairs. As a result of the Holocaust in Europe, unequal arms policies in favor of Arab states in the 1940s and 1950s, and the military successes of the IDF, Israeli leaders have generally assumed that at the end of the day Israel must be capable of defending itself against any and all of its Arab neighbors and that it could not and would not rely on other nations. It was for this reason that Israel, a small country, developed such a large military industry sector and such a robust military capability. It is for this reason that Israel developed its thinly-veiled nuclear arsenal. Israeli leaders preferred friendly relations with other nations especially the Western nations but always maintained an fundamental component of distrust and independence. Even the United States was not always seen as a reliable friend.

By 1991, the technological capabilities and potential capabilities of hostile states in the region and the ultimate reality of Israel's small size came together. At the strategic level, Israel realized it needed genuine allies which could balance its two most potentially deadly

opponents, Iraq and Iran as well as traditional rival, Syria. Diplomatically, Israel began to take actions to develop such relationships with Turkey²⁶ and perhaps India.²⁷ Israel is now openly debating whether to negotiate a formal alliance with the United States to replace the tacit alliance which has existed since 1967. The possible employment of Iraqi or Iranian weapons of mass destruction (WMDs) in the future has caused Israel to discourse less on retaliation and more on deterrence when discussing the possible use of its nuclear weapons. Longer range delivery systems and strategic targeting may replace the generally tactical posture that exists at present.²⁸

Israeli research and development establishments as well as Israeli defense industries are responding to this strategic shift as well as looking to their bottom lines. Whereas in previous years the industries were developed to support Israeli needs, there is now a shift occurring in which the R&D and industrial sectors are involved in more cooperative ventures with friendly nations, especially the United States. Israel and the United States are cooperatively working on a number of projects including sensors, precision weapons, and ballistic missile defenses.²⁹ Israel has signed cooperative ventures with the United States, Great Britain and the EU to acquire and exploit technical information on biotechnology, artificial intelligence, computer technology, material engineering, opto-electronics, neurosciences, and a host of other emerging technologies.³⁰ Obviously,

²⁶ Dov Waxman, "Turkey and Israel: A New Balance of Power in the Middle East," *The Washington Quarterly*, Vol 22, No. 1, Winter 1999.

²⁷ "India - and Israel Cooperate on Defense," *Periscope Daily News Capsules*, June 2, 1998 (United Communications Group Information Access Company, 1998).

²⁸ Harold Hough, "Israel Reviews its Nuclear Deterrent," *Jane's Intelligence Review*, Vol 10, Num 11, November 13, 1998 (Janes Information Group Limited, 1998) pages 13-19.

²⁹ The literature on this facet of U.S.-Israel cooperation is voluminous. Some examples are: David C. Isby, "Congress fund US Army Participation in THEL," *Jane's Missiles and Rockets*, Vol 2, Num 7, July 1, 1998 (Jane's Information Group Limited, 1998) Page 8; "Israel -US to Pay for Antimissile Missiles," *Periscope Daily News Capsules*, December 29, 1998 (United Communications Group Information Access Company, 1998); "Israel - U.S. to Fund R&D for Third Arrow Battery," *Periscope Daily News Capsules*, April 21, 1998 (United Communications Group Information Access Company, 1998).

³⁰ Edward H. Phillips (Ed.), *British/Israeli Pact*, *Aviation Week and Space Technology*, Vol 149, Num 22, Page 15 (McGraw-Hill Companies Inc, 1998); Brooks Tigner, "Israel to Join EU in Tech Research," *Defense News*, April 1, 1997 (Army Times Publishing Company, 1997).

all these technologies involve potential weapons that could be developed by or used against Israel, but these same technologies also could be used against the United States or NATO nations in a major theater war (MTW) and are thus of mutual interest

All of these political and technological changes have so effected the Israeli Defense Forces that they appear to be generating another local RMA. The IDF is virtually consumed with developing and deploying a national and theater Ballistic Missile Defense (BDM) system. It is working with the United States to develop the Israeli-designed Arrow system, but is also requesting permission to purchase Patriots and perhaps THAAD when it becomes available.³¹ The cultural implications of this transformation should not be underestimated. The fact that the IDF is spending so much intellectual effort and resources to develop a *defensive* system is a profound change in Israeli military culture which has historically emphasized the offense.

The Israeli development of the 1,500 kilometer-range Jericho II IRBM and the development of the Shavit II space booster which could, in effect, double as an ICBM represents a major victory of technology over technique in the Israeli military psyche. The development of unmanned missile systems to deliver Israeli nuclear weapons to distant Iran and Iraq if necessary is a physical admission of the difficulty the IAF would have accomplishing such a task with aircraft. The transformation of Israel's front line of defense from manned aircraft to offensive and defensive missiles will no doubt have significant ramifications for the culture of the IDF in the next decades and will no doubt shape the direction of doctrine, organization, and acquisition into the 21st Century.

Implications. This brief discussion of the Israeli path of innovation demonstrates to a remarkable degree how a nation can learn from its own history and mistakes as well as the experiences of other nations. The evolution of Israel from a small, less developed nation to

³¹ "Israel Wants to Buy Patriot Equipment" *BMD Monitor*, Vol 13, Num 13, June 25, 1998 (Pasha Publications Inc. 1998)

one in which precision-strike complexes, nuclear weapons, and advanced information systems form its defense is sobering. If Israel, a small nation with limited natural resources, could accomplish such a transformation, what are the implications for nations with more resources and larger populations? Israel has generally been a nation friendly to the United States, but what of such developments in nations which are not friendly?

It is clear that the technology and the knowledge base are globally available and that many nations could acquire or even develop advanced military capabilities and then use them against the United States. While it is possible that the U.S. might delay the acquisition of such capabilities, it will probably be unable to completely halt the technological and military evolution of potentially hostile powers.

Given the magnitude of the risks and the weapons involved, the United States military might also undergo a cultural transformation in which offense gives way to defense in the priorities of resources. Like Israel, the United States might find that its frontline of defense lies in antiballistic missiles rather than manned systems while it simultaneously uses its manned systems for "lesser contingencies."

Over the years it has been said that Israel needed to be the most robust, technologically advanced military power in the region because Israel was in a rough neighborhood of dictators, anti-Israeli ideologues, terrorists, and guerrillas. Israel developed its superb military because, unlike the United States which existed for many years in isolation from the troubles in Europe and Asia, Israel faced adversaries seeking to destroy it from the first moments of its existence. Many Israeli leaders continue to believe that regardless of peace talks and peace treaties, the Arab nations and Iran still wish to see Israel destroyed. Israel continues to believe it lives in a rough neighborhood and so will continue to develop and maintain a robust military and research establishment.

The United States also faces a changing array of threats at the dawn of the 21st Century. For over two hundred years the U.S. homeland has been removed from the vagaries of world politics. As the Millennium approaches, the entire world may well

become a bad neighborhood. The U S homeland itself may now be attacked by terrorists, fanatics, and regional dictators using all manner of weapons of mass destruction. In such an environment, the Israeli model of military innovation driven by constant peril may ultimately be a smaller version of the U S paradigm.

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